

# SECTION 02622 - CONCRETE PRESSURE PIPE, BAR-WRAPPED, STEEL- CYLINDER TYPE

## City of San Diego, CWP Guidelines

\$# \_\_\_\_\_

NTS: This Section is coordinated with Section 02600 such that it requires inclusion of that Section in the Contract Document.

\_\_\_\_\_\$

### PART 1 -- GENERAL

#### 1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing concrete pressure pipe, bar-wrapped, steel -cylinder type, complete in place.

#### 1.2 RELATED SECTIONS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
  - 1. Section 02140 Dewatering
  - 2. Section 02200 Earthwork
  - 3. Section 02600 Pipeline Construction
  - 4. Section 02653 Fabricated Steel Pipe and Specials
  - 5. Section 02666 Water Pipeline Testing and Disinfection
  - 6. Section 03315 Grout
  - 7. Section 09800 - Protective Coating
  - 8. Section 15000 Piping, General

#### 1.3 STANDARD SPECIFICATIONS

- A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC), as specified in Section 01090 - REFERENCE STANDARDS.

#### 1.4 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current additions of the following apply to the WORK of this Section:

ANSI/ASTM A 611	Specification for Steel, Cold-Rolled Sheet, Carbon, Structural
ANSI/ASTM E 165	Practice for Liquid Penetrant Inspection Method
AWWA C206	Field Welding of Steel Water Pipe

AWWA C208	Fabricated Steel Water Pipe Fittings
AWWA C303	Concrete Pressure Pipe, Bar-Wrapped, Steel- Cylinder Type
ASTM A 36	Specification for Structural Steel
ASTM A 283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 570	Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM A 572	Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality
ASTM C 150	Specification for Portland Cement
AWWA M-9	Concrete Pressure Pipe

## 1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300:

1. Certified dimensional drawings of all valves, fittings, and appurtenances.
2. Joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of wire or reinforcement; manufacturing tolerances; and all other pertinent information required for the manufacture of the product. [Joint details shall be submitted where deep bell or butt strap joints are required for control of temperature stresses.]
3. Fittings and specials details such as elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials where indicated which indicate amount and position of all reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions.
4. Design calculations [including a complete stress analysis] of each critical section of pipe wall, girth joints, and specials, all sufficient to ascertain conformance of pipe and fittings with the Specifications.
5. Material lists and steel reinforcement schedules which include and describe all materials to be utilized.
6. Full and complete information regarding location, type, size, material, method, and extent of all welds shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds and shall identify welds which merit special welding sequences or techniques. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.
7. Shop and field welding procedures and welders qualification certification.

8. Samples of welds in reinforcing rods and bars.
9. Samples of aggregate proposed for use in lining and coating.
10. Admixture information

#### 1.6 OWNER'S MANUAL

- A. **Certifications:** The CONTRACTOR shall furnish a certified affidavit of compliance stating that all pipe and other products or materials furnished under this Section of the Specifications comply with ANSI/AWWA C206, C208, and C303 and the following supplemental requirements:
  1. Physical and chemical properties of all steel.
  2. Hydrostatic test reports.
  3. Results of production weld tests.
- B. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

#### 1.7 FACTORY INSPECTION, TESTS, AND WELDING REQUIREMENTS

- A. The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental for [two] OWNER-designated inspectors for [ ] days required to complete such inspections or observations exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than fifty (50) miles outside the geographical limit of the City. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors. The CONTRACTOR shall comply with the requirements of Section 01400.
- B. **Inspection:** All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of ANSI/AWWA C303, a factory quality assurance program, and as supplemented by the requirements herein. The CONTRACTOR shall notify the CONSTRUCTION MANAGER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.
- C. **Tests:** Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C303, as applicable.
  1. After the joint configuration is completed and prior to lining with cement-mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the yield strength of the pipe steel cylinder.
  2. Tensile tests of production welds on steel cylinders and on lap- or butt-welded reinforcement bars shall be accomplished at the start of production and at intervals thereafter not to exceed each 3,000 feet of pipe. Each test shall consist of two samples prepared and tested in accordance with the applicable provisions of ASTM. Cylinder samples shall develop a stress of not less than 90 percent of the indicated minimum strength of the material being tested.
- D. The CONTRACTOR shall perform the material tests at no additional cost to the OWNER. The CONSTRUCTION MANAGER will witness all testing conducted by the CONTRACTOR, provided,

that the CONTRACTOR'S schedule is not delayed for the convenience of the CONSTRUCTION MANAGER.

- E. In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material including mixed concrete and lining and coating samples for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.
  - F. **Welding Requirements:** All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
  - G. **Welder Qualifications:** Welders, welding operators, and tackers shall be qualified in accordance with ANSI/AWWA C303 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.
- 1.8 FIELD TESTING
- A. Field testing shall conform to the requirements of Section 02666.
- 1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. All pipe and fittings shall be carefully handled and protected against damage to lining and coating on interior and exterior surfaces, impact shocks, and free fall.
  - B. **Handling and Storage:** The pipe shall be handled by use of wide slings, padded cradles, or other devices, acceptable to the CONSTRUCTION MANAGER, designed and constructed to prevent damage to the pipe. The use of chains, hooks, or other equipment which might injure the pipe will not be permitted. Pipe less than 60-inches diameter may be stacked 2 high; provided, each section is supported by resilient material to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the CONSTRUCTION MANAGER.
  - C. **Strutting:** Adequate strutting shall be provided on all specials, fittings, and straight pipe to avoid damage to the pipe and fittings during handling, storage, hauling, and installation.
    - 1. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe is loaded, transported, unloaded, installed and backfilled at the jobsite.
    - 2. The strutting materials, size and spacing shall be adequate to support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment.
    - 3. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced at no additional cost to the OWNER.
    - 4. The details of the strutting assembly shall be submitted for review by the CONSTRUCTION MANAGER prior to the start of pipe manufacture.

## PART 2 -- PRODUCTS

### 2.1 GENERAL

- A. Pipe shall conform to SSPWC subsection 207-4, ANSI/AWWA C303, and the following supplemental requirements.
- B. **Markings:** The CONTRACTOR shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" shall be painted or marked on the outside top spigot end of each pipe section.

\$#

---

NTS: In areas where differential settlement or liquefaction may occur, specify only raised bell joints and limit pipe length. Consider including or modifying Standard Detail C-195.

#\$

- C. **Laying Lengths:** Maximum pipe laying lengths shall be 40 ft with shorter lengths provided as indicated.
- D. **Offset Tolerances:** For pipe cylinder wall thicknesses of 3/8-inch or less, the maximum radial offset (misalignment) for submerged arc and gas metal arc welded pipe shall be 0.1875 times the cylinder wall thickness or 1/16-inch, whichever is larger. For pipe cylinder wall thickness of greater than 3/8-inch, the maximum radial offset shall be 0.1875 times the cylinder wall thickness or 1/8-inch, whichever is smaller.
- E. **Finish:** The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.
- F. **Closures and Correction Pieces:** Closures and correction pieces shall be provided as required to compensate for different headings in the pipe laying operation and to adjust the pipe laying to conform to pipe stationing shown. The locations of correction pieces and closure assemblies are shown. Any change in location or number of said items shall be acceptable to the CONSTRUCTION MANAGER.

### 2.2 PIPE DESIGN CRITERIA

- A. **General:** Except as provided in this Section, pipe shall be designed in accordance with ANSI/AWWA C303, and AWWA Manual M9 to withstand the simultaneous application of external loads and internal pressures.
- B. **Cylinder Thickness and Rod Wrap for Internal Pressure:** Pipe shall be designed in accordance with Section 4.5 of ANSI/AWWA C303 except that the area of rod reinforcement shall not exceed 40 percent of the total steel area (cylinder plus rod reinforcement) but in no case shall the design stress (using a safety factor of 2.0 to yield strength) be greater than 18,000 psi, at design working pressure nor shall the design stress (using a safety factor of 1.33 to yield strength) be greater than 24,000 psi at design transient pressure. Unless otherwise specified, the design working pressure is the pipe class and the transient pressure is limited to 1.33 times the working pressure. The cylinder

thickness for pipe less than 42-inch nominal diameter shall not be less than [No. 12 gauge (0.1046 in.)]

- C. **Cylinder Thickness and Rod Wrap for External Load:** Upon determination of cylinder thickness and rod wrap as described above, the deflection of the pipe shall be checked by the following formula:

$$\text{Defl}_x = \frac{DKWr^3}{EI + 0.0614 E'r^3}$$

Where:  $\text{Defl}_x$  = Vertical deflection of pipe in inches, not to exceed the square of the inside diameter divided by 4000.

D = Deflection lag factor, [1.00]

K = Bedding constant, [0.1]

W = Vertical load on pipe, lb/in (see Note 1)

r = Mean radius of pipe shell, inches


EI = Pipe wall stiffness, lb in<sup>2</sup>, (see Note 2)

E' = Modulus of soil reaction, lb/in<sup>2</sup>, [750]

Note 1: For depths of cover of 10 feet or greater, the earth load shall be computed assuming the trench/embankment condition as applicable. For depths of cover of less than 10 feet, HS-20 live load shall be included. For depths of cover of 3 feet or less, HS-20 live load plus impact shall be included. The determination of live load and impact factors shall be as recommended by AASHTO in "Standard Specifications for Highway Bridges."

Note 2: The term "pipe wall stiffness" as used here is defined as EI, where "E" is the modulus of elasticity (E=30,000,000 psi for steel and E=4,000,000 psi for mortar) and "I" is the transverse moment of inertia per unit length of pipe wall, the factors in the foregoing expression to be dimensionally compatible.

Earth Load for Trench Condition:

$$W_d = C_d w B_d^2$$


here:  $W_d$  = Earth Load in pounds per linear foot  
 $C_d$  = Load Coefficient  
 $Ku'$  = [0.11]  
 $w$  = [120] lb/ft<sup>3</sup>

W

$B_d$  = Trench width at top of pipe, feet  
 $H$  = Height of fill above top of pipe, feet

Earth Load for Positive Projecting Embankment Condition:

$$W_c = C_c w B_c^2,$$



$W_c$  = Earth Load in pounds per linear foot  
 $C_c$  = Load Coefficient (based on  $r_{sd}P$  of 0.25)  
 $K_u$  = [0.19]  
 $w$  = [120] lb/ft<sup>3</sup>  
 $B_c$  = Outside diameter of pipe, feet  
 $H_e$  = Height of Equal Settlement, feet  
 $H$  = Height of fill above top of pipe, feet  
 $r_{sd}$  = Settlement Ratio  
 $P$  = Projection Ratio

- D. If the calculated deflection,  $Defl_x$ , exceeds the square of the inside diameter divided by 4000, the composite pipe section shall be thickened or the quality of pipe zone backfill shall be improved to achieve a higher soil modulus (e.g., lean concrete, soil/sand cement, crushed rock). In no case shall  $Defl_x$  exceed 1-1/2 percent of the nominal pipe outside diameter.
- E. **Maximum Diameter:** The maximum diameter of pretensioned concrete cylinder pipe shall be 60 inches.
- F. **Welding of Joint Rings to Resist Thrust:** Where steel pipe with field-welded separate formed joint rings are used for thrust restraint, the joint rings shall be welded to the cylinder with double fillet welds unless shown otherwise.

\$# \_\_\_\_\_  
 NTS: Where pipelines are shown on plan and profile drawings, indicate the "pipe class" on the profile using a two number designation for pressure and external load, e.g., 150-10 means the pipe is designed to withstand a sustained internal pressure of 150 psi and an external earth load of 10 feet. The 150-10 pipe class will also be capable of withstanding an additional surge of 50 psi (1.33 times the working pressure) and any applicable live load HS-20 or E80.  
 \_\_\_\_\_ # \$

## 2.3 PIPE SCHEDULE

Pipe Designation or Pipe Class	Nom. Diam. (in)	Maximum Sustained Pressure (psi)	Cover Range (feet)	Trench Condition Outside Diam+(ft)	Minimum Compaction (percent)
[ 100-5 ]	[ 36 ]	[ 100 ]	[ 5 ]	[ OD+3 ]	[ 95 ]
[ 150-10 ]	[ 42 ]	[ 150 ]	[ 10 ]	[ OD+3 ]	[ 90 ]
[ 200-20 ]	[ 36 ]	[ 200 ]	[ 20 ]	[Embank]	[ 95 ]

## 2.4 MATERIALS

\$# \_\_\_\_\_

NTS: Type II cement should be specified for both the lining and coating except in those areas where soils analysis show a soluble sulfate concentration exceeding 2,000 ppm. In these locations, Type V cement should be specified for coatings and be made optional for linings.

\_\_\_\_\_ #

- A. **Cement:** Cement for mortar shall conform to the requirements of ANSI/AWWA C303; provided, that cement for mortar coating shall be Type [II] [V], and mortar lining shall be Type II or V. A fly ash or pozzolan shall not be used as a cement replacement.
- B. **Steel for Cylinders and Fittings:** Pipe manufactured under ANSI/AWWA C303 shall be fabricated only from steel which conforms to all the following requirements:
  1. One of the following:
    - ASTM A 570, Grades 30, 33, 36, or 40
    - ASTM A 36
    - ASTM A 283, Grade C or D
    - ASTM A 572, Grade 42
    - ASTM A 611, Grades B or C
  2. Has maximum carbon content of 0.25 percent
  3. Has minimum elongation at rupture of 15 percent in a 2-inch gauge length
  4. Has butt welded (using an approved electric fusion weld process) longitudinal and girth welds, whether straight or spiral.
- C. Steel reinforcement shall conform to ANSI/AWWA C303.
- D. Aggregate shall conform to ANSI/AWWA C303. Aggregate samples shall be submitted.
- E. Admixtures reducing water requirements or controlling set may be used according to ANSI/AWWA C303. The CONTRACTOR shall submit in writing any proposed admixture for approval.

## 2.5 SPECIALS AND FITTINGS



- A. Unless otherwise required under the Contract Documents, all specials and fittings shall be in accordance with Section 02653 and shall conform to the dimensions of ANSI/AWWA C208 and SSPWC Subsection 207-4.

## 2.6 PIPE CONSTRUCTION

- A. **General:** The pipe shall be bar-wrapped concrete pressure pipe with steel joint rings and rubber gaskets or field welded joints as shown. Pipe shall consist of a steel cylinder with attached steel joint rings, centrifugally lined with portland cement-mortar, spirally wrapped with circumferential steel reinforcing rod under measured tension and coated with portland cement-mortar.
- B. **Pipe Dimensions:** The pipe shall be of the class shown and of the inside diameter shown after lining.
- C. **Fitting Dimensions:** The fittings shall be of the diameter and class shown.
- D. **Joint Design:** The standard field joint shall be in accordance with Paragraph 4.5.3 of ANSI/AWWA C303. Flanged joints shall be furnished where shown.

## 2.7 CEMENT-MORTAR LINING

- A. **Cement-Mortar Lining for Shop Application:** Except as otherwise provided herein, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C303. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work and shall be approved by the CONSTRUCTION MANAGER. Every precaution shall be taken to prevent damage to the lining.
- B. The lining thickness shall be no less than 3/4-inch and tolerance shall be according to ANSI/AWWA C303.
- C. The pipe shall be left bare where field joints occur. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.
- D. Defective linings, as determined by the CONSTRUCTION MANAGER, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.
- E. The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas, is cured in accordance with the provisions of ANSI/AWWA C303. Cement-mortar for patching shall be the same materials as the mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.
- F. **Protection of Pipe Lining/Interior:** For all pipe and fittings with plant-applied concrete or cement mortar linings, the CONTRACTOR shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

## 2.8 EXTERIOR COATING OF PIPE

- A. **Shop Coating of Exposed Piping and Specials:** The exterior surfaces of pipe and specials which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09800.
- B. **Exterior Coating of Buried Piping:** All pipe for buried service, including bumped heads, shall be coated with a 1-1/4-inch thick cement-mortar coating over the rod wrap. Unless otherwise indicated, exterior surfaces of pipe or fittings passing through structure walls shall be cement-mortar coated from the center of the wall or from the wall flange to the end of the underground portion of pipe or fitting.

\$#

---

NTS: The requirement for coal-tar epoxy protective coating in the following paragraph should be specified only upon the recommendation of a qualified corrosion engineer for the following three conditions:

1. High chloride soils subject to alternate wetting and drying where the chloride ion concentration in the soil exceeds 1000 ppm and the soil resistivity, based on a statistical analysis of field measurements taken in the maximum natural moisture state, is lower than 1000 ohm-cm.
2. Acidic soils where the soil pH is below 5 and there is a probability of groundwater movement, i.e., fluctuating water table within the pipe zone. This condition rarely occurs except in peat bogs or man-made environments such as cinders, mine wastes, and industrial dumps. Other protective methods are often available such as impermeable clay backfill or calcareous backfill in the pipe zone.
3. Cathodic interference environments which cannot be fully mitigated by drainage bonds or other corrosion control practices.

---

#\$

- C. **Coal-Tar Epoxy Protective Coating:** The exterior surface of all pipe and fittings shall be protected with a minimum of 25-mil thick 100 percent solids coal-tar epoxy coating. The coating may be applied to freshly placed, partially cured, or cured [cement-mortar coating] [concrete surface]. Application shall be in accordance with the manufacturer's printed instructions.

## 2.9 MANUFACTURERS

- A. Products shall be of the following manufacture (or equal):
1. Coal-Tar Epoxy Protective Coating: **Amercoat 1972B**
  2. Foam-Lined Fabric for Grout Bands: **Dow Chemical Company, Ethafoam 221 or 222**

## PART 3 -- EXECUTION

### 3.1 INSTALLATION OF PIPE

- A. **Pipe Laying:** When the pipe is being laid, it shall be turned and placed so that any slightly damaged portion will be on top. The damaged area shall be repaired for the protection of any exposed steel. All damaged areas shall be repaired using materials and methods acceptable to the CONSTRUCTION MANAGER.
- B. Pipe struts shall be left in place until backfilling operations have been completed for pipe 42 inches in diameter and larger. Struts in pipe smaller than 42 inches may be removed immediately after laying, provided that the deflection of the pipe during and after backfilling does not exceed that specified. After the backfill has been placed, the struts shall be removed and shall remain the property of the CONTRACTOR.
- C. **Pipe and Specials Protection:** The openings of all pipe and specials where the pipe and specials have been cement mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be designed to prevent drying out of the interior of the pipe. The CONTRACTOR shall introduce water into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads. At all times, means shall be provided to prevent the pipe from floating.

### 3.2 WELDED JOINTS

- A. **General:** Field welded joints shall be in accordance with ANSI/AWWA C206 and the following.
- B. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.
- C. Butt straps, where used or required, shall be a minimum of 9 inches wide.
- D. After the pipe and pipe joint are properly positioned in the trench, the length of pipe between joints shall be backfilled to at least one foot above the top of the pipe. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.
- [E. To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours prior to the beginning of the welding operation and until the weld has been completed. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 45 degrees F.]
- F. Prior to the beginning of the welding procedure, any tack welds used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with ANSI/AWWA C206. Each pass except the first and final one shall be peened to relieve shrinkage stresses; and all dirt, slag, and flux shall be removed before the succeeding bead is applied.

- G. Welds shall be fitted welds, sized equal to the thickness of the cylinder, and be built up in 3 passes of not more than 1/8-inch per pass. Field welds shall conform to the requirements of shop welds except that automatic welding machines shall not be used.
- H. As soon as practicable after the welding of each joint, all field-welded joints shall be tested by the liquid penetrant inspection procedure conforming to the requirements of ANSI/ASTM E 165 under Method "B." All defects shall be chipped out, rewelded and retested. Upon retest, the repaired area shall show no leaks or other defects.
- I. Following testing of the joint, the exterior joint spaces shall be coated in accordance with these specifications after which backfilling may be completed.
- J. **Qualifications of Procedures and Welders:** All welding procedures used to install pipe shall be prequalified under provisions of ANSI/AWS D1.1. Welding procedures shall be required for field attachments and field welded joints.
- K. **Joints:** The pipe special fitting ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as shown on the Drawings.
- L. Unless double fillet welds are shown on the Drawings, field welded lap joints may, at the CONTRACTOR'S option, be made on either the inside or the outside of the pipe.

### 3.3 JOINT COATING AND LINING

- A. **General:** The interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe. The cement for joint grout shall be non-shrink grout as specified in Section 03315.
- B. **Joint Coating:** After the pipe has been laid and after sufficient backfill has been placed between the joints to hold the pipe securely in place, the outside annular space between pipe sections shall be completely filled with non-shrink grout formed by the use of polyethylene foam-lined fabric bands. The grout shall be composed of one part cement to not more than 2 parts sand, thoroughly mixed with water to a consistency of thick cream. The grout space prior to filling shall be flushed with water so that the surface of the joint to be in contact with the grout will be thoroughly moistened when the grout is poured. The joint shall be filled with grout by pouring from one side only, and shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Pouring and rodding the grout shall be continued to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than 3 joints of the pipe being laid.
- C. **Grout Bands (Diapers):** The grout bands or heavy-duty diapers shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh grout, resist rodding of the grout and allow excess water to escape. The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids alkalies and solvents.
- D. The fabric backing shall be cut and sewn into 9-inch wide strips with slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips 6 inches wide and slit to a thickness of 1/4-inch which will expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip

shall cover the full interior circumference of the grout band with sufficient length to permit an 8-inch overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.

- E. The polyethylene foam-lined grout band heavy-duty diaper shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with the steel straps. After filling the exterior joint space with non-shrink grout, the flaps shall be closed and overlapped in a manner that fully encloses the grout with polyethylene foam. The grout band shall remain in position on the pipe joint.
- F. **Joint Lining:** After the backfill has been completed to final grade, the interior joint recess shall be filled with non-shrink grout of stiff consistency mixed in proportions of one part cement to 2 parts sand. The non-shrink grout shall be tightly packed into the joint recess and troweled flush with the interior surface, and all excess shall be removed. At no point shall there be an indentation or projection of the non-shrink grout exceeding 1/16-inch. With pipe smaller than 24 inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with non-shrink grout containing one part cement to 2 parts sand. The spigot end then shall be forced to the bottom of the bell and excess grout on the inside of the joint shall be swabbed out.

### 3.4 INSTALLATION OF PIPE APPURTENANCES

- A. **Protection of Appurtenances:** Where the joining pipe is concrete or coated with cement mortar, buried appurtenances shall be coated with a minimum thickness of 1-1/4-inch of cement mortar having one part cement to not more than 2 parts plaster sand. [Following coating with cement mortar, the appurtenances shall be coated with coal-tar epoxy in accordance with Paragraph 2.8C.]
- B. **Installation of Valves:** All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to insure proper operation.
- C. All buried valves shall be coated and protected in accordance with Section 09800.
- D. All valves shall be installed so that the valve stems are plumb and in the location shown.
- E. **Installation of Flanged Joints:** Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only.
- F. All buried flanges shall be coated and protected in accordance with Section 09800.
- G. **Insulated Joints:** Insulated joints and appurtenant features shall be made by the CONTRACTOR as shown on the Drawings. The CONTRACTOR shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test will be performed by the OWNER. Should the resistance test indicate a short circuit, the CONTRACTOR shall remove the insulating units to inspect for damages, replace all damaged portions, and reassemble the insulating joint. The insulated joint shall then be re-tested to assure proper insulation.

[3.5 CORROSION CONTROL]

- [A. **Electrolysis Test Stations:** Electrolysis test stations shall be installed where shown.]
  
- [B. Corrosion mitigation and testing materials, such as magnesium anodes, reference electrodes, and test lead wire shall be furnished and installed by the CONTRACTOR where shown.]

- END OF SECTION -